Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

Correlation induced localization of lattice trapped bosons coupled to a Bose-Einstein condensate[1] PETER SCHMELCHER, KEVIN KEILER, SVEN KROENKE, Center for Optical Quantum Technologies - University of Hamburg, ZOQ THEORY TEAM — We investigate the ground state properties of a lattice trapped bosonic system coupled to a Lieb-Liniger type gas. Our main goal is the exploration and analysis of the two-species many-body quantum system including all relevant correlations beyond the standard mean-field approach. To achieve this, we use the Multi-Configuration Time-Dependent Hartree method for Mixtures (ML-MCTDHX). Increasing the lattice depth and the interspecies interaction strength, the wave function undergoes a transition from an uncorrelated to a highly correlated state, which manifests itself in the localization of the lattice atoms in the latter regime. For small interspecies couplings, we identify the process responsible for this cross-over in a single-particle-like picture. Moreover, we give a full characterization of the wave function's structure in both regimes, using Bloch and Wannier states of the lowest band, and we find an order parameter, which can be exploited as a corresponding experimental signature. To deepen the understanding, we use an effective Hamiltonian approach, which introduces an induced interaction and is valid for small interspecies interaction. We finally compare the ansatz of the effective Hamiltonian with the results of the ML-MCTDHX simulations.

[1]The collaborative research center SFB925 of the German Science Foundation is gratefully appreciated for financial support.

Peter Schmelcher
Center for Optical Quantum Technologies - University of Hamburg

Date submitted: 22 Dec 2017 Electronic form version 1.4